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Building Information Modeling (BIM) Practices for Information Technology Systems

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1 Introduction

1.1 General

Building information modeling (BIM) is the process of generating and managing building data during its lifecycle. BIM software can generate three-dimensional models used to support the design of a building. Utilizing BIM can incorporate detailed product information, quantities, and properties into the models. This added intelligence has huge potential for improving construction projects and ongoing facilities service. Just as the introduction of computer-aided design (CAD) software brought major advancements over hand drawings, BIM is dramatically altering how we communicate building design.

1.2 Purpose

The intent of this document is to expand the implementation of BIM in the telecommunications industry; explain the function and different elements of BIM and suggest which are most useful for telecommunications; and to recommend best practices for BIM's implementation and use.

The development of the BICSI BIM Standard reflects the importance of maintaining a good balance between the 3D modeling industry trends; the project basis of design modeling requirements; and the applicable Codes and Industry Standards. This Standard is based on the current BIM experience of many A/E firms and telecommunications industry experts. With the BICSI BIM Standards the ITS designer should be able to:

- Evaluate the benefits and requirements of BIM before engaging on a new project
- Better define the scope of work on a BIM project
- Have a reference point while designing for BIM
- Efficiently manage the BIM coordination

Finally, the intent of releasing this document is to provide the telecommunications industry a tool and Standard to meet the demands of the fast-paced BIM world.

1.3 Levels of Requirement

Two levels of requirement are specified - mandatory and advisory.

- Mandatory levels generally apply to protection, performance, administration, and compatibility; they specify the absolute minimum acceptable requirements.
- Advisory or desirable criteria are presented when their attainment will enhance the general performance of the BIM system in all its contemplated applications.

Mandatory requirements are designated by the word *shall*; advisory recommendations are designated by the words *should*, *may*, or *desirable,* which are used interchangeably within this standard. When possible, recommendations and requirements are separated to aid in clarity.

2 Scope

The scope of this document will explain the usage of BIM objects provided by product manufacturers as well as the "level of intelligence" integrated once these have been inserted to be part of the overall model. The "level of intelligence" term refers to the well defined Level of Detail (LOD) that each model is compromised by its components and design objects, (this will be elaborated further on this document). This document also attempts to guide the ITS designer:

- During the development process of the 3D model and related modeling tasks
- Throughout the coordination with all disciplines to maintain standardization among all the different low voltage systems
- To deliver an efficient lean model

3 Required Standards and Documents

The following standards and documents contain provisions that constitute requirements listed within this standard. Unless otherwise indicated, all standards and documents listed are the latest published version prior to the initial publication of this standard. Parties to agreement based on this standard are encouraged to investigate the possibility of applying a more recent version, as applicable.

Where equivalent local codes and standards exist, requirements from these local specifications shall apply. Where reference is made to a requirement that exceeds minimum code requirements, the specification requirement shall take precedence over any apparent conflict with applicable codes.

American Institute of Architects (AIA)

- E202, *Building Information Modeling Protocol Exhibit*

Building Smart Alliance (BSA)

- *National Building Information Model Standard*

Construction Specifications Institute/Construction Specifications Canada

- *MasterFormat: Master List of Numbers and Titles for the Construction Industry, 2012 Update*
- *UniFormat: A Uniform Classification System of Construction Systems and Assemblies, 2010 Edition*

National Institute of Building Sciences

- *Construction Operations Building Information Exchange (COBie)*

R.S. Means Company, Inc.

- *RSMeans Assemblies Cost Data*
- *RSMeans Building Construction Cost Data*
- *RSMeans Electrical Cost Data*

US General Services Administration (GSA)

- *GSA Building Information Modeling Guide Series*

4 Definitions, Acronyms, Abbreviations, and Units of Measurement

For the purpose of this standard, the following definitions, acronyms, abbreviations and units of measurement apply.

4.1 Definitions

category: The broadest level of classification of BIM content. A category encompasses object groups, types, and instances that have related functions or are parts of similar systems. Examples of categories include "walls," "doors," "electrical equipment" "cable trays," "security devices," and "communications devices."

COBie (Construction Operations Building Information Exchange): A standard, developed by the National Institute of Building Sciences in the U.S., for organizing building operations information. This information is used for building handover and facility management. Information is organized into a series of tables describing participants in the building's design and maintenance, floors in the building, spaces on floors, fixtures and equipment in spaces, periodic maintenance for equipment, spare parts suppliers, serial numbers, etc. Some of the information can be extracted from an architect's or engineer's BIM model, while other information must be supplied by contractors or facility managers.

content: Collectively models of devices, equipment, fittings, etc., which are suitable for use in BIM project models.

content Model: A model, at the type or object group level of classification, depicting devices, equipment, fittings, etc., which can be instanced into a project model at multiple locations. A content model can be either a product model, representing a specific product, or it can be generic, representing a device where the specific model has not yet been selected.

firm: This refers to a consultant company, such as an MEP "firm." This will be referenced in the context of "an RCDD's 'firms' content"

generic: Non-manufacturer-specific content. Generic content is used by some firms in the early building design phases, because full requirements are not fully known at such an early stage.

instance: The most specific level of classification of BIM content, encompassing a single device, installed at a single location in a single project.

model: A computer representation which simulates something in the real world. Depending on context, this term can refer to a BIM project model, individual BIM product models that are to be placed in BIM project models, generic content, or even a simple 3D (non-BIM) model of a geometric form.

object: The representation of a building component in a BIM system. A BIM object includes the geometric form of the building component, as well as any graphic symbol used to represent the component in plan drawings, non-graphical data such as manufacturer name or required voltage, and behavior of the component such as being able to be circuited to electrical panels or being able to be placed in a wall.

object group: An intermediate level of classification of BIM content, more specific than a category, but capable of encompassing multiple closely related types that are similar in form and function. Examples could vary from manufacturer to manufacturer, but might include "two-post racks," "angled patch panels," "faceplates," etc.

NOTE: In programming vernacular, object groups are also known as "families".

parameter: A data field comprising part of the definition of an object. Examples include "manufacturer," "mounting height," "voltage," or "field of view."

product model: A piece of BIM content representing a product (or several similar products) from a particular manufacturer.

project model: A BIM model of a building or other construction project, created by placing many instances of various generic or product models.

reflected ceiling plan: A type of scaled drawing, common in architecture but uncommon in technology design, in which the underside of a ceiling is drawn as if the floor of the building was a mirror and the ceiling appeared reflected in it.

rendering: Computationally producing a high-quality image of a model, usually by tracing the paths of many rays of light. Rendering often takes into account such factors as the position and characteristics of light sources; colors, patterns, and bumpiness of surfaces in the model; reflections; transparency; translucency; and diffraction. Rendering (as opposed to simple shading) performed by high-end rendering software can produce images that are difficult to distinguish from photographs of the real world.

scale-dependent: Having a graphical depiction whose plotted size is dependent on the scale of the drawing in which it appears, i.e., being drawn to scale.

scale-independent: Having a graphical depiction whose plotted size is always the same, regardless of the scale of the drawing in which it appears. For example a triangular symbol for a faceplate, which always appears 4.8 mm (0.19 in) on a side, regardless of the scale of the drawing.

type: An intermediate level of classification on BIM content, generally corresponding to a particular make and model of device, which may be installed at multiple locations in a project.

value: An actual quantity, measurement, text string, selection, or other evaluation of a parameter associated with an instance or object type. Examples of values might include "Thingamabobs, Inc." (for a manufacturer), "107cm" or "42in" (for a mounting height), "120V" (for a voltage), or 30 degrees (for a field of view). Some values are constant for a particular product (with other products having other values), while other values can vary from instance to instance.

4.2 Acronyms and Abbreviations

Abbreviations and acronyms, other than in common usage, are defined below.

2D	two dimensions
3D	three dimensions
A/E	architectural/engineering
AHJ	authority having jurisdiction
BIM	building information modeling
BPM	building product manufacturer
CAD	computer-aided design
CD	construction document
COBie	construction operations building information exchange
ESS	electronic safety and security
IPD	integrated project delivery
LOD	level of development
MEP	mechanical electrical plumbing engineering design consultant/firm
NCS	national CAD standard
OSP	outside plant
PoE	power over Ethernet
RCP	reflected ceiling plan
RFI	request for information
WAP	wireless access points

4.3 Units of Measurement

The units of measurement used in this standard are metric. Approximate conversions from metric to U.S. customary units are provided in parentheses; e.g., 100 millimeters (4 inches).

Units of measurement used in this standard are defined below:

ft	foot
in	inch
m	meter
mm	millimeter

5 BIM Project Design

5.1 Overview

Within the planning and implementation of a project, there are several phases where specific actions related to BIM need to occur. The following sections provide information about BIM tasks for specific projects stages.

5.2 Pre-Schematic Design

Establish a BIM expectation plan containing the following:

- Establish model sharing schedule and process
- Model coordination objectives and tolerances
- Level of development
- Progress schedule – what is to be seen in the model and at what phases
- BIM startup matrix – what needs to be modeled for other disciplines to start
- Project origin point or common working point – to be established collaboratively at the beginning of the BIM documentation phase amongst the team members.
- Specific project areas of concern

Document E202, *BIM protocol exhibit,* provides further information and considerations for the above items.

5.3 Schematic Design

Tasks and elements of the BIM project during schematic design include:

- Establish the horizontal equipment layouts, duct mains, large diameter conduits, cable tray, and pipe mains. Establish the vertical ducts, conduits, and pipes that will be going floor to floor (e.g., shafts and chases).
- The team shall review each other's plans and discuss any changes that should be made
- The team shall work out initial generic space zones for the each trade.

  Examples include:

  – Lights at ceiling
  – Fire protection run between lights
  – Water & gas piping – 250 mm (10 in) above ceiling (as measured from the bottom of piping)
  – Mechanical pipe – 250 mm (10 in) above ceiling (as measured from the bottom of piping)
  – Ductwork – 450 mm (18 in) above ceiling (as measured from the bottom of the duct)
  – Pitched piping above as tight to structure as possible

- The team shall model all clearance requirements for their equipment
- BIM lead shall include files for all disciplines and set up the batch for the model

5.4 Design Development

Tasks and elements of the BIM project during design development include:

- BIM lead shall review the model and run the clash report.
- Team shall discuss changes needed to clear up any clashes. If it is determined that assistance from the architect or others is required to clear some clashes, the BIM lead will take snap shots from the model showing the conflicts. These shall be sent to the appropriate party for resolution.
- Discuss the next steps once all clashes are resolved and the appropriate space required for the design the team has modeled has been provided.

5.5 Bid Documents

Tasks and elements of the BIM project during creation and review of bid documents include:

- Issues with required space need to be resolved and completed by the design team.
- The following shall be modeled as required:
    - Telecommunication room
    - Cable tray, conduits, optical fiber duct, and other contiguous cable pathway systems
    - Cabinets, frames, and racks
    - Telecommunication devices
    - Devices shall be modeled to the overall height, width, and depth to the specific project
    - Telecommunication system backbone pathway.
    - Telecommunication cables, J-hook supports, and individual outlets wall conduit stubs may be modeled on per project basis
    - Access control coordinated with door hardware (as applicable)
    - Card readers and door operators (as applicable)

        These objects shall be modeled as required, subject to the accuracy of architectural drawings and software capability.

- Quantities and locations of telecommunications outlets shall be coordinated with the electrical engineer for rough-ins to ensure there is power adjacent to each outlet.
- Check for any remaining coordination issues. For example, the designer may wish to verify piping for liquids or HVAC ductwork shall not be routed through telecom spaces, unless serving the room. The ceiling space should be clear to allow the routing and installation of cable tray and cables. The height should be at least 2.6 m (8.5 ft) and false ceilings shall not be installed.
- Each discipline shall complete their BIM modeling
- Team shall clear up all conflicts ("clashes")

5.6 Construction Documents

A/E is expected to continuously maintain and update the model(s) with changes made during construction, as required.

5.7 A/E Contract Close-out

A/E shall update their respective models with contractor recorded changes. Republish record documents. Also submit full model with all needed objects and reference drawings, in original authored software and in IFC format (as required).

NOTE: Discuss possible changes to close-out requirements, as needed, with the owner or owner's representative.

5.8 Project Audit

Once the first BIM project is complete, it is important to determine how well the workflow worked and how the workflow needs to be modified. By looking at several factors, problem areas will be highlighted and can be addressed prior to engaging in additional BIM projects.

- Accuracy and integrity of the model
- Process adoption
- Project successes and failures
- Project deliverables
- Coordination
- Costs
- RFI and addendum quantity